Naming Acids, Bases, and Salts

Acids: ("H" out front)

a. binary acids-have only two elements
prefix is always hydro--
suffix is always --ic
stem is the element

Ex:

binary acid	prefix	stem	suffix	name
HCl	hydro	chlor	ic	hydrochloric acid
HI	hydro	iod	ic	hydroiodic acid

b. ternary acids-have three elements(usually the third element is oxygen)
oxyacid-an acid with hydrogen, oxygen and a third element

per--STEM--ic	1 more oxygen
STEM--ic	most common form
STEM--ous	1 less oxygen
hypo--STEM--ous	2 less oxygen

Ex:

compound	# of oxygen atoms	prefix	STEM	suffix	name
$HClO_4$	4	per	chlor	ic	perchloric acid
$HClO_3$	3	----	chlor	ic	chloric acid
$HClO_2$	2	----	chlor	ous	chlorous acid
HClO	1	hypo	chlor	ous	hypochlorous acid

Common --ic forms:
$HClO_3$(chloric), HNO_3(nitric), H_2CO_3(carbonic), H_3PO_4(phosphoric), H_2SO_4(sulfuric), H_3BO_3(boric), HIO_3(iodic)

Bases:("OH" at the end)
Naming: adding the word hydroxide to the name of the positive ion

NaOH	sodium hydroxide
$Ca(OH)_2$	calcium hydroxide

Salts: a compound composed of the positive ion of an aqueous base and the negative ion of an aqueous acid.

NaCl

NaOH HCl

double salt-where two different kinds of metallic ions are present

$KCaPO_4$	potassium calcium phosphate

when binary acids form salts, the acid --ic ending changes to --ide ending

HCl	hydrochloric acid	NaCl	sodium chloride

for ternary acids:
if the acid ending is --ic, the salt ending is --ate
if the acid ending is --ous, the salt ending is --ite

~~$HMnO_4$~~	~~permanganic acid~~	~~$KMnO_4$~~	~~potassium permanganate~~
HNO_2	nitrous acid	KNO_2	potassium nitrite
HClO	hypochlorous	KClO	potassium hypochlorite

Acid-reacts with water to form hydronium ions(H_3O^+)
sour taste(never taste) ex: lemons, citric acid,vinegar

Base-tastes bitter ex: soaps with lye

Theories:

1. Arrhenius

acid- produces H^+ in aqueous solution ex: $HCl \longrightarrow H^+ + Cl^-$

base-produces OH^- in aqueous solution ex: $NaOH \longrightarrow Na^+ + OH^-$

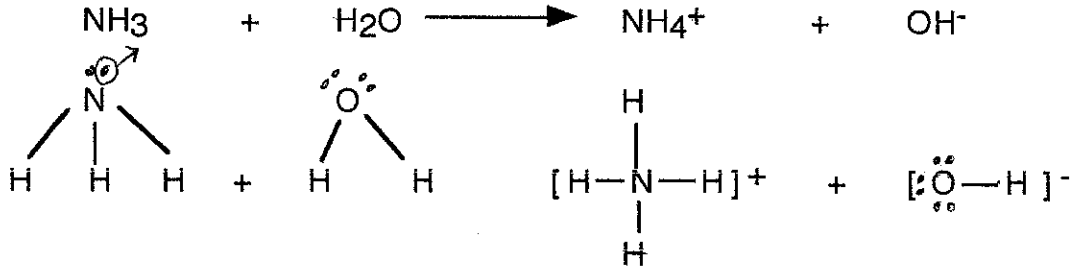
2. Bronsted-Lowry(we will mainly concentrate on this type)
acid-proton donor
base-proton acceptor

$HCl + H_2O \longrightarrow H_3O^+ + Cl^-$

acid base

the acid donates a proton(H^+) to the water and becomes H_3O^+. the base accepts the proton to become Cl^-

3. Lewis theory
acid-electron pair acceptor
base-electron pair donor



conjugate acid-formed when the base accepts a proton from the acid
conjugate base-the remaining particle of the acid after a proton is relased
an acid is paired with its conjugate base and a base is paired with its conjugate acid

ex: $HCl + H_2O \longrightarrow H_3O^+ + Cl^-$

acid base conjugate acid conjugate base

$H_3O^+ + Cl^- \longrightarrow HCl + H_2O$

acid base conjugate acid conjugate base

$NH_3 + H_2O \longrightarrow NH_4 + OH^-$

base acid conjugate acid conjugate base

Acidic and Basic Anhydrides
anhydride-without water

acidic anhydride-a nonmetal oxide that dissolves in water and produces an acid

ex: SO_2 + H_2O ⟶ H_2SO_3
nonmetal oxide (acidic anhydride) — water — acid

basic anhydride-a metal oxide that dissolves in water and produces a base

ex: Na_2O + H_2O ⟶ $2NaOH$
metal oxide (basic anhydride) — water — base

Will the following produce an acid or base and write the formula

1. Li_2O

2. CO_2

Write the formula of the anhydride and also state if the original substance is an acid or base

1. $Ba(OH)_2$

2. H_2SO_4

NAMING: Acids, Bases, and Salts

Name the following and state whether it is an acid, base, or a salt

1) HF

2) H_2CO_3

3) H_3PO_2

4) KOH

5) $MgCl_2$

6) $Mg(OH)_2$

7) KCl

8) HNO

9) Sulfurous acid

10) Sodium fluoride

11) Calcium hydroxide

12) Hydroiodic acid

13) Hypochlorous acid

14) Magnesium persulfate

15) Aluminum hydroxide

WORKSHEET: Acids, Bases , and Anhydrides

I. State the acid, base, conjugate acid, and conjugate base for the following:

1) HPO_4^{-2} + H_2O ------> H_3O^+ + PO_4^{-3}

2) H_2O + H_2SO_4 ------> H_3O^+ + HSO_4^-

3) NH_3 + H_2O ---------> NH_4^+ + OH^-

II. Write the formula for the acid or base formed from the following anhydrides. (Metallic anhydrides ---> base, nonmetallic anhydrides ----> acids). State whether your answer is an acid or a base.

Ex: BeO $Be(OH)_2$ Base

1) HgO

2) SO_2

3) N_2O_3

4) CO_2

5) K_2O

6)Fe_2O_3

III. Write the formula for the anhydride for the following. State whether the original substance is an acid or a base.

Ex: NaOH Na_2O Base

1) H_2SO_4

2) HIO_3

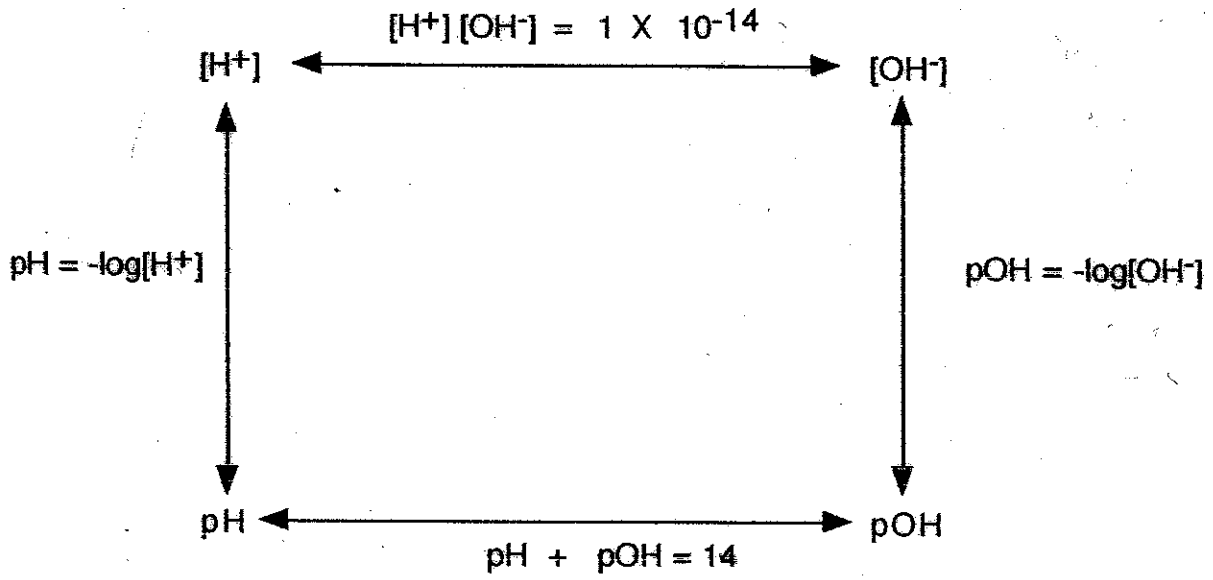
3)H_2CO_3

4)CsOH

5)$Zn(OH)_2$

6)$Ba(OH)_2$

ACID-BASE EQUATION SHEET



Worksheet: pH, $[H_3O^+]$

I. Find the pH of the following given its Molarity (concentration). State whether it is acidic, basic or neutral.

Recall: $pH = -\log[H_3O^+]$

1. 1×10^{-5} M

2. 4.37×10^{-4} M

3. 1×10^{-3} M

4. 1×10^{-6} M

5. 6.59×10^{-10} M

6. 7.01×10^{-6} M

7. 9.47×10^{-8} M

8. 6.89×10^{-14} M

9. 9.1×10^{-3} M

10. 6.14×10^{-12} M

II Find the $[H_3O^+]$ for the following given the pH. State whether it is acidic, basic, or neutral.

Recall. $[H_3O^+]$ = antilog [-pH]

1. pH = 8

2. pH = 2.3

3. pH = 4

4. pH = 7.83

5. pH = 2.3

6. pH = 9.821

7. pH = 1.355

8. pH = 3.68

9. pH = 12.41

Worksheet: Acids and Bases

Find the pH, pOH, $[H^+]$, $[OH^-]$, K_w, or pK_w as appropriate and state if the solution is acidic or basic

1. If $[H^+] = 6.2 \times 10^{-3}$ Find $[OH^-]$

2. If $[H^+] = 2.6 \times 10^{-12}$ Find pOH. Do this two ways!!

3. If $[OH^-] = 1.25 \times 10^{-2}$ Find pOH and pH

4. If $[OH^-] = 3 \times 10^{-4}$ Find pOH and pH

5. ~~If $[H^+] = 2.5 \times 10^{-3}$ Find $[OH^-]$~~

6. If $[OH^-] = 9.6 \times 10^{-7}$ Find pOH

7. If $[OH^-] = 2.5 \times 10^{11}$ Find pOH

8. If pH = 2.9 Find $[OH^-]$. Do this two ways!!!

9. If $[H^+] = 1.7 \times 10^{-8}$ Find pOH. Do this two ways!!

10. If pH = 11.6 Find $[OH^-]$. Do this two ways!!!

11. If $[H^+] = 4.37 \times 10^{-4}$. Find pH

12. If pH = 6.2. Find $[H^+]$

13. ~~If pH = 13.8. Find $[H^+]$~~

14. If $[H^+] = 1.58 \times 10^{-12}$. Find pH

15. If $[H^+] = 2.9 \times 10^{-3}$. Find pH

Advanced Chemistry Series III Number 3

Acid - Base Titration

Amounts of reactants and products in a reaction are commonly investigated in two ways in the laboratory: Gravimetrically (by mass), and volumetrically (by volume and concentration). Titration is the name given to the process used to determine the volume of a solution needed to react with a given mass, or volume of a sample. We will use this process to study quantitatively the reaction between an acid and a base. The hydrogen ion from the acid reacts with the hydroxide ion from the base to produce water.

Phenolphthalein will be used as the indicator in the experiment, since its color change occurs when the same number of moles of hydrogen ion and moles of hydroxide ion have been added. This point in a reaction is called the equivalence point.

Using hydrochloric acid of known concentration, you will first standardize a sodium hydroxide solution, that is, determine its concentration expressed as moles per liter. With this standard base, you will then titrate a sample of hydrochloric acid that has unknown concentration.

Procedure:

1) Obtain two burets. Be sure to read in your notes about the care and use of burets. Clean the burets and rinse the one on the left with a few ml of the hydrochloric acid which you will be using in it. Rinse the one on the right with a few ml of the sodium hydroxide solution you will be using in it. After rinsing the burets, fill the first with the acid of known concentration and the second with the base.

2) Before you do the titration, you will need to obtain enough base to complete the unknown. obtain about 150 ml. You may store it in a fleaker.

3) Record the value on each buret to the nearest 0.01 ml. (It is not necessary to start at zero). To a clean 250 ml Erlenmeyer flask let out about 15 ml of the hydrochloric acid. To this add two drops of phenolphthalein.

4) Hold the neck of the Erlenmeyer flask with one hand and manipulate the buret with the other. Add sodium hydroxide and gently swirl the flask so the solutions will mix. Continue adding sodium hydroxide until the first faint pink color develops. If the color disappears upon mixing the solution, add more sodium hydroxide, drop by drop, until a pink color persists for at least 10 seconds. One drop should be enough to change the solution from colorless to pink when the equivalence point has been reached.

5) Practice titrating by first adding a small amount of acid and then enough base to reach the equivalence point. These practice titrations should be done in the same flask without discarding any of the solution. Continue these practice titrations until you

have added at least 20 ml of the more dilute solution (the one you have used more of). After the equivalence point has been reached this time, record the buret readings for both solutions. Discard the solution from the flask.

6) Refill each buret with the proper solution. Rinse the Erlenmeyer flask thoroughly. Repeat the titration two more times. This time it is not necessary to practice titration using a few drops at a time. Run into the flask enough acid so that when the equivalence point has been reached you will have used about 20 ml of the more dilute solution. Then titrate to the equivalence point, using the necessary amount of base. Remember, the larger the volume used the smaller the percent uncertainty in the volume measurements.

7) Calculate the ratio of acid volume to base volume used in each titration. These ratios should be in good agreement, or additional titrations may be necessary.

8) Obtain enough unknown HCl solution to fill the buret. Be sure to record the exact date you obtain the unknown. Titrate the solution to determine the concentration of the unknown, using the sodium hydroxide solution standardized above.

I. Title: Lab: Acid-Base Titration
II. Purpose: you state this!!!
III. Data: Part I: standard acid vs NaOH (get it signed!!!)

trial	initial acid ml	final acid ml	initial base ml	final base ml	volume acid ml	volume base ml	Molarity NaOH mol/ L
						AVERAGE	

Part II: NaOH vs unknown molarity of HCl

trial	initial acid ml	final acid ml	initial base ml	final base ml	volume acid ml	volume base ml	Molarity HCl mol/ L
						AVERAGE	

IV. Calculations:
1. Determine the molarity of the unknown acid. Show all work!!

V. Analysis Questions:
1. What makes something an acid or a base?
2. List five properties of acids and bases.
3. What is an indicator?
4. Why did we need to do two tirations for this lab? (Why can't we use the standard acid to find the unknown acid?)
5. List two possible lab errors. State if the error would make the final molarity of the unknown acid larger or smaller or no change and why. Do this for both of the errors.

VI. Conclusion
Two paragraphs: summarize the procedure, and,tell me what you learned.

Accuracy Grade
0.00 to 2.00% error -0 2.01 to 5.00% error -1 5.01 to 10.00% error -2
10.01 to 15.00% error -3 15.01% error and greater -4

ACID/BASE: Take home quiz (30pts) NAME: _____

Name of Acid/Base: _____

Formula of Acid/Base: _____

Physical properties: Color _____, Odor _____

1) Is this Acid/Base consider strong or weak ? Explain.

2) Give a reaction that would produce this acid or base. Classify this reaction.

3) What color would the indicator phenolphthalein be in the presence of your acid or base ? (Explain)

4) What color would the indicator bromthymol blue be in the presence of your acid or base ? (Explain)

5) If you had a 0.25 M solution of your acid or base, calculate its:

a. $[H^+]$

b. $[OH^-]$

c. pH

d. pOH

6) List two uses for you acid or base.

* Attach and highlight references